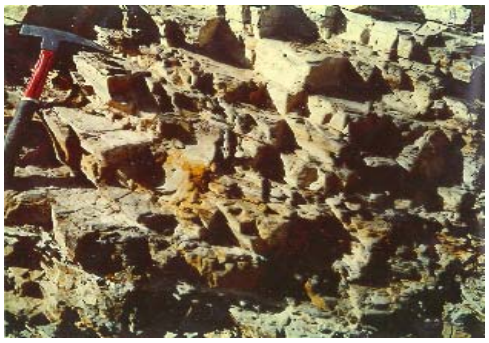
Sandia National Laboratories

# Geomechanics Department

## Focus

The Geomechanics Department addresses cross-cutting issues in the geosciences and geoengineering related to rock mass characterization, rock mass mechanics, development of numerical codes and numerical simulations, validation of material models and design procedures, and rock mass site monitoring. Supported by combinations of laboratory work and *in situ* observations, the Geomechanics Department emphasizes:

- Characterization of natural fracture systems
- Identification /modeling of rock deformation and failure processes.
- Laboratory determinations of thermomechanical and transport properties of competent rock and natural fractures, including studies of coupled effects.
- Extrapolation of laboratory measurements to field conditions.
- Rock mass and geologic characterization using remote sensing methods.
- Laboratory and bench-scale validation studies.



*Joint rock mass*

## Laboratory Facilities

*Load frame and pressure* vessel

- 0.1-5 MN capacity servocontrolled testing machines
- 1 MN/10kN-M normal load/torsion testing machine
- 70 MPa – 1 GPa pressure vessels(15cm maximum cavity diameter)
- True triaxial testing capability
- Hopkinson/Kolsky bar for intermediate rate testing (2.5 cm sample diameter)
- Triaxial creep apparatus ($10^{-10}s^{-1}$ strain-rate resolution)
- Elevated temperature testing to 200°C.
- Triaxial testing at low temperatures to -60°C.
- Permeability apparatus with hydrostatic and deviatoric loading capabilities
- Non-Destructive testing facilities including real-time acoustic emissions location system
- Petrographic laboratory
- Specialty machining and sample preparation facilities

## Selected Projects

*Shear Strain Localization and Evolution of Fracture Systems in Rock:* Study of shear localization and factors favoring localization (inhomogeneties, anisotropy, and yield-surface corners) under axisymetric and true three-dimensional stress states (sponsor: DOE and National Petroleum Technology Office)

*Columbia Shuttle Accident and Return to Flight Projects:* Characterization of special component materials for modeling the response of the space shuttle heat protection system to potentially damaging impacts. (sponsors: NASA and Lockheed Martin)

NNSA National Nuclear Security Administration

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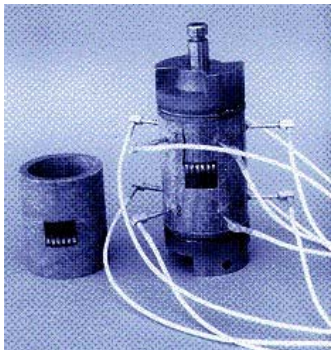
*High Temperature Laboratory Creep Data for Special Concretes:* Experimental studies and modeling of creep and relaxation in concrete temperatures up to 200°C for applications to repository design (sponsor: Yucca Mountain Project)



*Thin-walled rock cylinder before torsion test under pressure*

*Constitutive Behavior of Frozen Soils:* Experimental program to determine the properties of frozen soils using a novel triaxial cell capable of triaxial compression at 500 MPa confining pressure and 60°C. (sponsor: DOE Defense Programs)

*In Situ Rock Mass Characterization:* Use of active and passive ultrasonic transducer arrays to study the development of disturbed zone around openings in salt (sponsor: Waste Isolation Pilot Plant Project)

*In Situ Geomechanics Testing:* Design and implementation of large-scale *in-situ* thermal/mechanical tests to study the thermal, hydrological, and mechanical behavior of rock mass under thermal loading (sponsor: Yucca Mountain Project)

*Geotechnical Characterization of Underground Storage Facilities:* A suite of joint Sandia/ Industry projects to evaluate the feasibility of large scale storage of compressed gas and liquid petroleum in selected geologic formations.

*Material Behavior Under Impulsive Loading:* Study of rock response under dynamic loading, especially near the transition from stress-corrosion dominated crack propagation to kinetic-effects, dominated cracking, for application in drilling, blasting, and penetration problems (sponsor: DOE Defense Programs)

*Characterization of Brittle Materials:* Study of the response of brittle materials including plastics, epoxies, and ceramics for electronics and other applications to determine their constitutive behavior and fracture characteristics under multi-axial loading (sponsor: DOE Defense Programs).

*Mechanics of Powder Compaction:* Laboratory determination of the mechanical behavior of ceramic and metal oxide powders and development of models to simulate the compacting process. (sponsors: DOE Defense Programs and various Industrial Partners).

*Rock Penetration:* Experimental and analytical research to determine the fundamental rock deformation mechanisms and response during rapid penetration. (sponsor: Laboratory Directed Research & Development)

*Geomechanics of Reservoir Management:* Sandia/industry program concerning the effect of *in situ* stress and production –induced stress changes on mechanical and fluid-flow properties of reservoir rocks and natural fractures (sponsor: DOE National Petroleum Technology Office).

*Installation of Single Heater Test at Yucca Mountain*

*Development of a Coupled Fluid Flow-Particle Motion Code:* This code employs the Discrete Element Method coupled with the fluid flow using the lattice-Boltzmann method to simulate the mechanical response of porous media to fluid flow. (sponsor: DOE National Gas & Oil Technology Partnership)

*RemoteGeo:* Developing methods to characterize the geology and determine rock properties using remote sensing methods. (sponsor: Laboratory Directed Research & Development)

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